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STATE OF WASHINGTON
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July 7, 2015 15-NWP-120

Mr. Ryan Beach, General Engineer
Office of River Protection
United States Department of Energy
PO Box 450, MSIN: H6-60
Richland, Washington 99352

Re: Department of Ecology's (Ecology) Completed Review of *Phase 2 RCRA Facility Investigation Report for Waste Management Area C*, RPP-RPT-58339, Revision A Draft

Dear Mr. Beach:

Ecology has completed the review of the referenced document which was submitted with Letter 14-TF-0131, dated December 23, 2014, to fulfill Milestone M-045-61.

In addition to this review, Ecology provided comments on two supporting documents: *Baseline Risk Assessment for Waste Management Area C*, RPP-RPT-58329, Revision 0, and *Screening-Level Evaluation of Groundwater Monitoring Data Collected in the Vicinity of Waste Management Area C*, RPP-RPT-58297, Revision 0. Enclosed are Review Comment Records with Ecology's comments.

The United States Department of Energy – Office of River Protection, Washington River Protection Solutions, LLC, and Ecology have been meeting monthly to discuss format, content, and provide technical information for the Resource Conservation and Recovery Act Facility Investigation (RFI). The enclosed comments are mainly in the following areas:

- Groundwater contamination and source definition.
- Baseline Risk Assessment.
- C Farm residual Waste Inventory.
- Data Gaps in the understanding of the nature, extent, and migration of past releases at Waste Management Area C.

Ecology requests that the monthly meetings continue as part of the comment resolution process for the RFI. Ecology recognizes the RFI is just a beginning step in the corrective action process and subsequent WMA C Closure activities.

If you have any questions, please contact me at jeff.lyon@ecy.wa.gov or 509-372-7914.

Sincerely,

Jeff Lyon
Tank Systems Operations and Closure Project Manager
Nuclear Waste Program

M-045-61
1228921, 1227926

mb/aa
Enclosures
cc: See page 2

cc electronic w/enc:
Dennis Faulk, EPA
Rebecca Gerhart, EPA
Christopher Kemp, USDOE
Jon Perry, MSA
Marcel Bergeron, WRPS
Susan Eberlein, WRPS
Ken Niles, ODOE
Michael Barnes, Ecology
Joe Caggiano, Ecology
Damon Delistraty, Ecology
Beth Rochette, Ecology
Cheryl Whalen, Ecology
Environmental Portal
Hanford Facility Operating Record
USDOE-ORP Correspondence Control

cc w/enc:
Administrative Record
NWP Central File

cc w/o enc:
Rod Skeen, CTUIR
Gabriel Bohnee, NPT
Russell Jim, YN
Steve Hudson, HAB
NWP Reader File

REVIEW COMMENT RECORD	Date	Review No.
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Document Number(s)/Title(s)	Program/Project/Building Number	Reviewer	Organization/Group	Location/Phone
RPP-RPT-58339, Phase 2 RFI WMA-2, Rev. A Draft	NWP - TSOC	ECY	WA Dept of Ecology	Mike Barnes - Lead 372-7927

Comment Submittal Approval: Agreement with indicated comment disposition(s) Status:

Organization Manager (Optional) Date

Reviewer/Point of Contact Date

Author/Originator

Reviewer/Point of Contact

Author/Originator

Item	Page #/section # Line #	Comment (s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/ problem indicated.)	Hold Point	Disposition (Provide justification if NOT accepted.)	Status
1.	General Comment				
2.	1-9, lines 31-33	RPP-PLAN-37243, Rev 2 states that the PA will be used to support the RFI (Section 3.4.1). That is no longer the case. Please identify what portions of the Master Plan are still applicable. Specific issues: • RPP-PLAN-37243, Rev 2, pg 4-2: "Specifically, this interrelationship shows the CMS feeding back into the performance assessment and closure plan "development & revision" in recognition that WMA contaminated soil is an integral component of the WMA final closure decision making process." – RFI shows CMS as separate from the closure plan with no feedback (see Fig 1-4)			

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3.	1-9, lines 33-34	"The integration between the vadose zone program and the groundwater program is described in Section 5 of this master work plan (RPP-PLAN-37243)." The material is not in Section 5, please correct.			
4.	1-9, lines 34-37	"Additional detail regarding integration of RCRA and CERCLA requirements for closure of WMA C, specifically, is contained in RPP-46459, *Single-Shell Tank Waste Management Area C RCRA/CERCLA Integration White Paper*."			
5.	5-123, line 20	"Additionally, IX in the vadose zone can significantly impact the mobility of some contaminants" Is "IX" defined?			
6.	5-127, line 1 5-127, line 26 5-127, line 38 5-128, line 16 5-128, line 20 5-128, line 23 5-129, lines 9-11 5-129, line 22	"maximum concentration was 30,600 J µg/kg from" "The maximum concentration was 101,000 U at Investigation Group P from a depth of 5 m (15 ft) bgs (shallow)." "…concentration was 110,000 M µg/kg at a depth of…" Also "The maximum reported concentration was 3.13 U pCi/g from Investigation Group P" "concentration was 9.45 U pCi/g from Investigation Group P" "Iodine-129 was detected in one sample at a concentration of 0.808 B pCi/g…" "maximum reported value was a non-detect result of 76 BYUJ pCi/g from Investigation Group L1+L2 at a depth of 35 m (115 ft) bgs (deep), however, the highest detected value was 53.5 Y pCi/g from Site U at a depth of 39 m" "The maximum concentration was 1.85 B pCi/g from" Typos?			
7.					

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Document Number(s)/Title(s)	Program/Project/Building Number	Reviewer	Organization/Group	Location/Phone
RPP-RPT-58339, Phase 2 RFI WMA-C, Rev. A Draft RPP-RPT-58297, Screening-Level Evaluation of Groundwater Monitoring Data Collected in the Vicinity WMA-C, Rev. 0	NWP - TSOC	Beth Rochette	WA Dept of Ecology	Mike Barnes - Lead 372-7927

Comment Submittal Approval: Agreement with indicated comment disposition(s) Status:

Organization Manager (Optional) Date

Reviewer/Point of Contact Date

Author/Originator

Reviewer/Point of Contact

Author/Originator

Item	Page (P), Section (S), Line (L)	Comment (s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/ problem indicated.)	Hold Point	Disposition (Provide justification if NOT accepted.)	Status
1.	*RFI Chapter 5* p. 5-83, lines 9-10	The document states "A peak ^{137}Cs concentration of 1,200,000 pCi/g was detected at 15.24 m (50 ft) bgs in C6403..." There are no data reported for C6403 in Table N-5. The data for C6403 need to be added to table N-5 (Appendix N). Overall, Group P is fairly contaminated, with chromium, ^{137}Cs, ^{241}Am, and nitrite.			
2.	*RFI Chapter 5* p. 5-108, lines 1-7	The document states "From the 55 constituents reviewed as part of the screening-level evaluation, only seven constituents were considered likely to be of interest for assessing the potential or cancer risks for noncancerous hazards or investigating potential groundwater contamination sources at WMA C." Other contaminants need to be considered. To resolve this comment, please address the following set of comments for the screening-level document (RPP-RPT-58297).			
3.	**RPP-RPT-58297,**	Please provide Ecology with the data set that was used for this document.			

	Rev. 0 General				
4.	**RPP-RPT-58297, Rev. 0** Executive Summary p. i	The objective for the document is given twice with different statements that aren't consistent: (1) "The primary objective of the evaluation is to identify a set of groundwater analytes of interest that report concentrations greater than comparison values developed for protection of human health (Maximum Contaminant Levels and risk-based standards) in the vicinity of WMA C." (2) "The primary purpose of this evaluation is to provide supplemental information to support the WMA C Resource Conservation and Recovery Act of 1976 (RCRA) facility investigation/corrective measures study process and the ongoing investigations into potential contributions to current and future groundwater contamination from sources in the vadose zone at WMA C." Note that the first objective above is the objective given for this document on p. 5-106 of the RFI. The purpose of this document needs to be clarified. If either of the above objectives is correct this should be a primary document for Ecology's review and approval, because the decisions made in this document about contaminant elimination influence risk assessments that will be needed for closure, and potentially compliance monitoring.			
5.	**RPP-RPT-58297, Rev. 0** Executive Summary p. ii	The text states "Based on the analyte-specific evaluation, 17 of 24 analytes with maximum detected concentrations greater than their respective comparison values were not carried forward. This is troubling because all detected contaminants can easily be carried into the risk assessment, and the 17 deleted contaminants actually had occurrences above concentrations of concern. Carry all 24 detected contaminants into the risk assessment. Prepare sections in the document that address each of the 24 contaminants and their relative contributions to risk and/or hazard.			
6.	**RPP-RPT-58297, Rev. 0** p. 2-7, Section 2.3.3	Screening of contaminants beyond comparison with background and detection limits is not warranted. Further screening is beyond the approaches recommended in USEPA (1989, Risk Assessment Guidance for Superfund) for cases when computer resources are available. Since site risk and hazard indices are based on sums of individual contaminant risk values and hazard quotients (the latter for contaminants with similar modes of action or target organs), the sums will underestimate risk if contaminants have been eliminated from consideration prior to the risk calculations. Furthermore, maximum values do not reflect data variability and are not consistently conservative enough for screening. The 95% UCL values should be calculated and			

		presented to indicate the variability within the data.			
7.	**RPP-RPT-58297, Rev. 0** p. 3-9 to 3-36, Table 3-4	The following 'Groundwater Method B Screening Levels' need to be revised: DDD – revise 0.36 to 3.6 E-02 ug/L DDE and DDT – revise 0.26 to 2.6E-02 ug/L Di-n-octylphthalate – revise 19 to 16 ug/L Fluoride – revise 96 to 48 Styrene – revise 160 to 1.46 ug/L Vinyl chloride – revise 0.061 to 0.029 ug/L			
8.	**RPP-RPT-58297, Rev. 0** p. 5-2, Section 5.3	As mentioned for Section 2.3.3, contaminant screening beyond considering detection and availability of toxicity information should not be performed. These further screening steps are not consistent with Risk Assessment Guidance for Superfund (USEPA, 1989). A variety of criteria are to be considered when determining if data are of sufficient quality for use in a quantitative risk assessment. These criteria include the appropriateness of the analytical methods, quantitation limits, data qualifiers and codes, blank concentrations, tentatively identified compounds, potential to be site-related, and background concentrations (USEPA, 1989). Beyond these criteria, any elimination of contaminants from inclusion in the risk assessment is considered by USEPA (1989) to be optional. When discussing the optional criteria for reduction in the number of chemicals to include in the risk assessment, Section 5.9 (USEPA, 1989) states, "If conducting a risk assessment on a large number of chemicals is feasible (e.g., because of adequate computer capability), then the procedures presented in this section should not be used. Rather, the most important chemicals (e.g., those presenting 99 percent of the risk) – identified after the risk assessment – could be presented in the main text of the report, and the remaining chemicals could be presented in the appendices." Therefore, comparison against a concentration threshold should not be used as a basis for eliminating contaminants, because a contaminant can contribute to exceedence of a risk or hazard threshold while still being below the chemical threshold for the individual contaminant. Also, use of a maximum detected value can underestimate the population mean value when the data set is small and variable.			
9.	**RPP-RPT-58297, Rev. 0** p. 5-3 – 5-8, Table 5-1	There are a few contaminants that can be considered and added to this table by using surrogates for toxicity information: acenaptheylene (use acenaphthene), delta-BHC (or-HCH; use beta-HCH); endosulfan sulfate (use endosulfan); endrin aldehyde (use endrin).			

10.	**RPP-RPT-58297, Rev. 0** Section 5.4 – General	The wells listed below and their associated contaminants are of concern because they have elevated concentrations of a variety of contaminants, including contaminants that may be excluded from risk assessments or future monitoring (data from 2008-2013). In many cases individual contaminants exceed criteria of concern, though in some cases it is the total hazard index, or total cancer risk that exceeds criteria. Contaminants that exceed 1% of risk or hazard are included. These contaminants should be retained for both risk assessments and future monitoring in the wells where they have been detected. Since the contaminant concentrations in groundwater at WMA C have been in flux for the past several years, it should not be assumed that they are stable enough to eliminate contaminants that have been observed as recently as 2008. Well 299-E27-14 Associated Unit: WMA C Carcinogens: Arsenic, I-129, Tc-99, tritium, uranium (as isotopes) Hazards: Arsenic, cobalt, copper, cyanide, nitrate (N), vanadium Well 299-E27-15 Associated Unit: WMA C (just outside) Carcinogens: Arsenic, I-129, Tc-99, tritium Hazards: Arsenic, antimony, selenium, nitrate (N), nickel, vanadium, uranium Well 299-E27-155 Associated Unit: WMA C (just outside) Carcinogens: I-129, Pu-239/240, Tc-99, tritium, carbon tetrachloride Hazards: Cyanide, hexavalent chromium, nitrate (N), selenium, vanadium Well 299-E27-4 Associated Unit: WMA C (just outside) Carcinogens: I-129, Tc-99, tritium Hazards: Nitrate (N), nickel Well 299-E27-7 Associated Unit: WMA C (just outside) Carcinogens: I-129, Tc-99, tritium Hazards: Cyanide, nitrate (N), vanadium			

11.	**RPP-RPT-58297, Rev. 0** p. 5-41, Section 5.4.1	All detected radionuclides should be carried forward and summed using a sum of fractions approach and decay rates. Daughter products should also be considered. Notice that plutonium was detected in well E27-155 in both 2008 and 2013. This should also be discussed in the document.			
12.	p. 5-42, Section 5.4.2	Antimony should be included in hazard calculations (and monitored) for well E27-15 and downgradient wells. Its hazard quotient is additive with nitrate, and vanadium (using the ATSDR intermediate-duration MRL for blood effects for vanadium).			
13.	**RPP-RPT-58297, Rev. 0** p. 5-42, Section 5.4.2	Arsenic should be included in hazard and risk calculations (and monitored) for wells E27-14 and E27-15 and downgradient wells. Also, when defining background Ecology uses the 90th percentile (or 4 times the 50th percentile, whichever is lower) for lognormal populations, rather than the whole range of background sample results (WAC 173-340-709).			
14.	**RPP-RPT-58297, Rev. 0** p. 5-42, Section 5.4.2	Chromium should be included in hazard calculations (and monitored) unless a separate analysis was or will be performed for hexavalent chromium. If total chromium is the only result available for a well it should be included in the calculations as hexavalent chromium, since trivalent chromium has limited solubility at the pH of this groundwater (therefore, the majority of dissolved chromium may be hexavalent).			
15.	**RPP-RPT-58297, Rev. 0** p. 5-42, Section 5.4.2	Cobalt and copper should be included in hazard calculations (and monitored) for well E27-14 and downgradient wells. Their hazard quotients exceeded 1 at well E27-14 as recently as 2008 and 2009.			
16.	**RPP-RPT-58297, Rev. 0** p. 5-49, Section 5.4.2	Hexavalent chromium should be included in hazard calculations (and monitored) at well E27-155 and downgradient wells. It was detected too recently (2008 and 2009) to dismiss.			
17.	**RPP-RPT-58297, Rev. 0**	Selenium should be included in hazard calculations (and monitored) at wells E27-15 and E27-155 and downgradient wells. Selenium has common toxicological targets with arsenic (skin) and hexavalent chromium (GI, using the ATSDR MRL for			

	p. 5-49, Section 5.4.2	hexavalent chromium for chronic exposure). Also, Ecology defines background as the 90th percentile (or 4 times the 50th percentile, whichever is lower) for lognormal populations, rather than the whole range of background sample results (WAC 173-340-709).			
18.	**RPP-RPT-58297, Rev. 0** p. 5-50, Section 5.4.2	Uranium should be included in hazard and risk calculations (and monitored) for well E27-15 and downgradient wells. The concentration in well E27-15 was greater than the MCL in 2008, and this well was once downgradient of the C-200 (high uranium) tanks and associated UPRs.			
19.	**RPP-RPT-58297, Rev. 0** p. 6-1, Section 6.0	The third paragraph of the section states "Cyanide, nitrate, sulfate and ^{99}Tc appear to be correlated with a release from WMA C, with declining concentrations." It does not appear from the data for well E27-21 that concentrations of ^{99}Tc, nitrate and sulfate are decreasing, or that nitrate is decreasing at E27-14. This statement should be modified in consideration of these exceptions.			
20.	*RFI Chapter 6* p. 6-6, lines 14-21.	The point of compliance for DOE O 435.1, 100 m from the down-gradient boundary of WMA C, is not consistent with the state groundwater point of compliance, which is 'throughout the site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the site' (WAC 173-340-720(8)(b)). Please add discussion of this point of compliance and how it will be addressed. Using a point of evaluation at the fenceline (as was previously intended for the WMA C Performance Assessment) would be close to the state's point of compliance.			
21.	*RFI Chapter 6* p. 6-22, Table 6-2, and p. 6-45, Table 6-11	Table 6-2 presents parameters for the 'denominator case'. As a reminder, Ecology is not satisfied with the recharge assumptions for this case, as it does not consider disturbance of the barrier and associated higher recharge. The least of such disturbances is fire and invasive species, which could reset recharge rates to greater than 20 mm/y for decades (Norton, JB, TA Monaco, JM Norton, DA Johnson, TA Jones. 2004. *Soil morphology and organic matter dynamics under cheatgrass and sagebrush-steppe plant communities.* J. of Arid Environments 57:445-466). Larger disturbances such as construction activities of inadvertent intruders would cause significantly greater changes by potentially removing large portions of the barrier, possibly leaving the remainder more prone to erosion (consider that no person living now or contemporary agency can ensure that the land will not be used in unexpected ways after a century or more). Table 6-11 also does not consider common or more drastic barrier disturbances.			

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22.	*RFI Chapter 6* p. 6-22, Table 6-2	The table gives sorption characteristics for only 3 of the contaminants of concern. The document should give sorption characteristics for all of the contaminants of potential concern.			
23.	*RFI Chapter 6* p. 6-44, lines 39-40	The document states that chemicals with Kd values greater than 3 mL/g were excluded because their arrival times at the water table would be beyond the 10,000 year time period under future recharge conditions. Please re-evaluate this using sensitivity case 3 on Table 6-6, and include all contaminants that would reach groundwater under those conditions.			

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Document Number(s)/Title(s)	Program/Project/Building Number	Reviewer	Organization/Group	Location/Phone
RPP-RPT-58339, Phase 2 RFI WMA-C, Rev. A Draft	NWP - TSOC	Mike	WA Dept of Ecology	Mike Barnes - Lead 372-7927

Comment Submittal Approval: Agreement with indicated comment disposition(s) Status:

Organization Manager (Optional) _____ Date

Reviewer/Point of Contact _____ Date

Author/Originator

Reviewer/Point of Contact

Author/Originator

Item	Page #/section # Line #	Comment (s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/ problem indicated.)	Hold Point	Disposition (Provide justification if NOT accepted.)	Status
1.	General Comment	Chapter 1 discusses the expectations for the content, context, and uses of this WMA C RFI. It is noted this document will serve as the basis for other documents meeting milestones for the WMA C corrective action process. It is suggested that all parties review the milestone dates and content of documents to make sure all required items are covered.			
2.	Figure 2-15	Table 2-1 event 7-1979 Occurrence report 79-73 discusses failure of a 4 inch water line supplying raw water to WMA C. There is no 4 inch water line on the map or a water line shown near the west side of tanks C-111/C-112. Please discuss. A north arrow on ALL maps would greatly help in orienting the proper map direction especially when the individual tanks are not numbered. With no water line near C-111 and C-112 the spill could have been much larger.			
3.	2.4.5.9 Clastic Dikes	These were discussed at the WMA C PA meetings. I agree with your summation on clastic dikes but would note clastic are very well seen at the submarine storage pit in 200East area.			

4.	2.4.6.2	Please discuss in the final report the status of complete barometric corrections at WMA C wells. This should be updated and included in the final report. Final report should discuss if this change in flow direction has changed or been enhanced.—goes to future GW flow patterns---			
5.	3.3.1.1 last sentence	Please clarify exactly what "all of the MW sludge was removed from the tanks" means. Does this mean all as in zero is left or all that could be effectively removed by sluicing—thus, a small heel would remain?			
6.	3.3.1.3 1st and 2nd paragraph	Check agreement of text with Table 3.2 C-103 received CW waste in 1960 and C-110 did NOT receive any CW waste according to the table.			
7.	3.4	I would include this table for completeness of the interim stabilization for C Farm HNF-SD-RE-TI-178 Rev. 9 TANK NO | PAGE NO | STAB MTHD | DATE STAB Stabilization Record The record is summarized by fiscal year and stabilization method: Administrative (AR), Supernate (SN), and Saltwell (Jet).			

		C-101 | 131 | AR | Nov-83 C-102(2) | 133 | JET | Sep-95 C-103(2) | 139 | JET | Jul-03 C-104 | 147 | AR | Sep-89 C-105 | 149 | AR | Oct-95 C-106(6) | -- | N/A | N/A C-107(2) | 151 | JET | Aug-95 C-108 | 158 | AR | Mar-84 C-109 | 160 | AR | Nov-83 C-110 | 162 | JET | Jun-95 C-111 | 167 | SN | Mar-84 C-112 | 168 | AR | Sep-90 C-201 | 170 | AR | Mar-82 C-202 | 171 | AR | Aug-81 C-203 | 172 | AR | Mar-82 C-204 | 173 | AR | Sep-82 (1) Stabilization evaluation data missing. (2) Stabilized due to major equipment failure. (3) Date in parentheses is date that Interim Stabilization documentation was completed. (4) This tank was originally jet pumped in 1978, but not declared stabilized until 1988. (5) This tank was originally jet pumped in 2000, but was only declared stabilized after retrieval was completed. (6) This tank was never saltwell pumped, it went directly to retrieval.			
8.	Section 3.6	SECTION 3.6 in general is lacking specific details on the nature and amounts of waste that are shown in Table 3-3. Below is verbage from the RFI guidance on waste characterization and its importance.			

		Waste and unit characteristics will also provide information for-determining release rates and other release characteristics (e.g., continuous as opposed to intermittent). Waste and unit information is-also important for determining the nature and scope of any corrective measures which may be applied. Without adequate waste characterization, it is difficult to ensure, that all constituents of concern will be monitored during the release investigation, unless all possible constituents are monitored Waste characterization should also be designed to provide sufficient information to support the implementation of interim measures and/or corrective measures. In general I find Table 3-3 lacking the details on specific constituents of concern; as well as the volume estimates. Table 3.3 should list current estimates of waste inventory and characterization of the ancillary equipment. It is uncertain if 90% retrieval completion is possible given the differences in size and shape of the ancillary equipment as compared to the 100 or 200 series tanks. My concerns are listed below:			
9.	3.6.1 and 3.6.2	Retrieved Tanks and NOT yet Retrieved Tanks I find the waste residual inventory description/calculation confusing at best: I would say that for all retrieved tanks: Residual waste volume is calculated by either the CAD system or by volume displace differential The tanks are then sampled with Ecology approved SAP/TSAP and the residual inventory is then calculated. For those retrieved tanks C-101, C-107, and C-112 which had not been sampled and analyzed at the date of publication waste concentration estimates have been used.			

		For the final RFI due 12/31/2016 it is doubtful that analysis of all of the tanks will be completed at the time of the cut-off date. Based on the issues present today with tanks C-102, C-105 and C-111 it is extremely doubtful that retrieval will approach the 10.2m ^{3} (360 ft^3) performance goal used for the NOT yet retrieved tanks.			
10.	3.6.3 Ancillary Equipment	In the second paragraph you state that no decision or direction has been given to date regarding removal of waste from ancillary equipment. This is not true; Ecology has given direction for retrieval and removal of waste from the C-301 catch tank see letter (11-NWP-045 of May 25, 2011 from Jeff Lyon to Scott Samuelson *Re: Catch Tank **C-301** Retrieval Feasibility Study,* RPP-RPT-45723 Accession # 1106011341. The C-301 Catch Tank From RPP-RPT-45723 seems important to sample and analyze for retrieval purposes The 241 -C-301I catch tank is assumed to contain the waste types involved in active 241 **-C** tank farm waste transfers for the period 1949 to **1980 (WHC-SD-EN-ES-040,** *Engineering Study of/SO Miscellaneous Inactive Underground Radioactive Waste Tanks Located at the Hanford Site Washington).* The acquisition of current liquid and solid samples are necessary to support any future retrieval operations from the 241 **-C-30 1** catch tank. The result from the analyses impacts the ultimate design and deployment of the final catch tank retrieval system and transfer alternatives. The acquisition of liquid and solid samples from the catch tank are being pursued. Updated liquid and solid waste levels should be measured when samples are obtained from the catch tank. **If** the waste level of the catch tank has increased from the **1985** level, then the most likely cause could be attributed to rainwater intrusion. In the event the liquid level is substantially less, or missing, then a leak from the tank would be suspected and the tank integrity would be considered compromised. The potential for evaporative losses from			

		the tank are minimal since the tank is sealed and there is no ventilation, either passive or active. The integrity of the catch tank would influence the selected method of retrieval. Ecology has repeatedly asked for information and a schedule for the activities on C-301 Catch Tank and no response has been given to date.			
11.	3.6.3.1	Catch Tank and 244-CR Vault You display little if any information on amount of waste or content in the text so there is no way to confirm the information for C-301 catch Tank and 244-DR Vault shown on Table 3-3. The following information was copied from Waste Tank Summary report for Month Ending November 30, 2014 Table 5-1 on page 37 of the report see the report as it shows an estimated sludge level of ~10,000 gallons among the 4 vault tanks. This distribution of waste is much different than what have seen in reports from the 1990s work. I will note the vault cells and resulting precipitated solids were used for specific purposes as thus the average concentration of waste used for other cell characterization approximations may/may not be advisable. However, it may not be possible or worthwhile to develop specific approximation differences for each of the cells. This is probably something Ecology, ORP and WRPS should discuss before the final RFI. I would suggest these values from the Waste tank Summary Report are better estimates as given in TOC-PRES-14-3310 –FP Revision 0 in **Case Study in Corporate Memory Recovery: Hanford Tank Farms Miscellaneous Underground Waste Storage Tanks - 15344** Prepared for the U.S. Department of Energy Assistant Secretary for Environmental Management From the document "The MUST waste volumes, waste level measurements, tank calibration tables, waste volume calculations, and supporting primary references were packaged and			

		published as a separate document [6], and the HNF-EP-0182, *Waste Tank Summary* tables updated with the new waste volumes." 244-CR Vault/ **C** Farm B, BX, BY, **C** Farm sludge **3.6** 2/25/2014 **(70)** TK-CR-001 slurry 244-CR Vault/ **C** Farm Process jumper connection **<0.10 3/3/2010 (70)** Sump-CR-001 leaks or cell decon washdowns 244-CR Vault/ **C** Farm 244-CR Vault Tank CR-001 **0.75** 11/29/2004 **(70)** TK-CR-002 244-CR Vault/ **C** Farm Process jumper connection **<0.10 3/09/2010 (o)** Sump-CR-002 leaks or cell decon washdowns 244-CR Vault/ **C** Farm Former **C** Farm saltwell **2.3** 2/25/2014 **(70)** TK-CR-003 receiver tank 244-CR Vault/ **C** Farm Process jumper connection **<0.10 3/10/2010 (70)** Sump-CR-003 leaks or cell decon washdowns 244-CR Vault/ **C** Farm 244-CR Vault Tanks CR-002 4.0 11/30/2004 **(70)** TK-CR-0I1 and CR-003 244-CR Vault/ **C** Farm Process jumper connection **<0.10 2/25/2010 (70)** Sump-CR-0 11 leaks or cell decon washdowns Nominal volume of remaining waste is in kgal, unless noted otherwise. DCRT = double-contained receiver tank. PUREX = plutonium/uranium extraction. **HVAC =** heating, ventilation, and air conditioning. **27** **(70)** 244-CR Vault contains two 40-kgal tanks, CR-01 **I** and CR-001, and two 15-kgal tanks, CR-002 Table **5-I** and CR-003, in individual cells. The contents of the 244-CR Vault cells were pumped to Tank **C-104** during retrieval of Tank C-104. Pumping was completed on March **10,** 2010 (RPP-RPT-45845, *Completion of Pumpable Liquids Removal from 244-CR Vault).* The completion letter was sent to ORP on April **28, 2010** (Dunning 2010). Tank volumes are from RPP-RPT-24257, *244-CR Vault Liquid Level Assessment and Video Inspection Completion Report.* Following WRPS-PER-2012-0724, quarterly monitoring of Tank CR-001 was implemented in April **2013 by** installation of an ENRAF monitoring device; the volume is derived from zip cord measurements, as converted from RPP-CALC-24219, *244-CR Vault Tank and **Cell** Volume (Talculations.*			
12.	3.6.3.2 Pits	3.6.3.2 Pits Would you please go over in more detail how the estimated volume of the pits was derived; not			

		that 32 gallons is a lot of waste but I can't follow the calculation nor do I understand what a grout formulation factor of 0.30 has to do with anything. Are valve boxes included in the "pits" for C Farm? I note page 3-11 states there are three valve boxes and one valve pit in C farm. Is there expected to be any residual inventory or contamination in the valve boxes?			
13.	3.6.3.3 Diversion Boxes	3.6.3.3 Diversion boxes If you state that any waste in the diversion boxes will be removed after retrieval than I would expect the closure plan to list a step for opening up each of the diversion boxes and confirming there is no waste remaining. Question: how do you plan to measure no contamination remaining after retrieval?			
14.	Ground water detected species	From the December 2010 Groundwater Monitoring Report SGW-49716-VA Rev. 0 Please discuss. SST C – Dangerous constituents detected in groundwater in December 2010: cyanide, nickel, vanadium, acetone, and chloroform – Contaminants above drinking water standards include nitrate, sulfate, I-129, and Tc-99 SST C organics assessment – Acetone and chloroform were detected in December 2010; the results are under investigation because they are near the detection limit, and other organics indicate potential blank contamination – Chloromethane and tetrachloroethene also were detected in December 2010 samples, but were detected in lab QC blank, so they are likely caused by lab contamination			
15.	Iodine 5.4.1.6	The text description grossly understates of the magnitude of the iodine contamination when compared to the 2012 contaminant plume map			

		(SGRP\GISProjects\MXD\CP\200PO1\CHSGW20140770.mxd). The plume map shows an iodine plume that extends for miles and includes both BP-5 and PO-1 groundwater units; of which WMA C is but a small part of this plume. It is correct that no local impacts of iodine or potential releases from WMA C are known to have occured. Significantly more information of the nature of these iodine releases is warranted as well as any other information of constituent releases with the iodine is necessary.			
16.	Sulfate comments: 5.4.1.3 p5-110	In the last paragraph of the section you say E27-24, E27-14, E27-7 and E27-25 are impacted by a local release of sulfate from WMAC. In the preceding paragraph you say E27-25 has a comparable trend with E27-10 (near B-2 ditches) and with the historical trend and southward groundwater flow these wells are impacted by releases from 216-B-2 ditches. Wouldn't other wells in the vicinity of E27-25 be similarly impacted? What about well E26-8? According to Phoenix 26-8 was last sampled in 2013 with a value of 33,200 with E-27-25 with a recent sulfate value of 308,000. If sulfate migrated from the B-2 ditches why would it not migrate to E 26-8? I judge E26-8 to be about 600 feet from E27-25. Please clarify and provide a trend comparison of E27-25 with E27-10. What other groundwater constituents were discharged at B-2 ditches and could thus be expected in the groundwater at WMA C or in the vicinity. In general, how do the sulfate concentrations in the groundwater at WMA C compare to other tanks farms and the rest of the site?			
17.	Nitrate 5.4.1.2 p.5-110	Here, you say the elevated nitrate at well E27-25 may be associated with unplanned releases associated with discharges to the 216 B-2 Ditches. How far are the B-2 ditches from WMA C? Why would a release from this area impact only well E27-25 and no other wells in the vicinity of WAC? Again E26-8 had a reported value in PHOENIX of 753 ug/L in 2013 with a high of ~4000 ug/L in 2006. I note the nitrate concentrations at E27-10 are ~50-60,000ug/L.			
18.	Technetium-	Your suggestion on Tc-99 ratios in wells E27-21 and E27-23 is interesting; however, there is			

	995.4.1.7 p 5-112-113	another possibility to explain this. That is the nitrate associated with the technetium-99 release(s) makes up just a small component of the nitrate in the groundwater due to nitrate releases within WMA C. The change in groundwater flow has dramatically reduced the Tc-99 at E27-23 with a slight decrease in nitrate concentration and at E27-21 there has been a dramatic increase in Tc-99 with little change in nitrate. Several other wells (A-AX) have seen recent increase in tc-99 to above the drinking water standard E24-33 and E24-22. Is the Tc-99 increase in wells E24-33 and E24-22 due to technetium releases from WMA C? What is the current extent of technetium-99 contamination from WMA C in 2015 and do you have a projection of where the plume will be in 2025? Describe the basis for the extent of technetium contamination as shown in the 2012 contaminant plume map. Do you have an estimate of the Tc-99 curie content present in and around the WMA C technetium plume? Has this technetium-99 plume from WMA C now responsible for the recent rise in technetium at WMA A/AX groundwater wells?			
19.	Cobalt-60	Cobalt-60 has been detected in some WMA C wells. See PNNL-15837 page 4.111 for discussion of cobalt60 detection in 1992-1994. PHOENIX also has detectable quantities of cobalt in 2013. Please include a full discussion on what this means for cobalt being detected in E27-12 and E27-14 at the same period given they are on the north side and one on the south sideof the farm and implications of cobalt contamination within the farm around tanks C-105 and C-108.			
20.	Suggestions for the Final RFI of WMA C:	WMA C groundwater has been contaminated by events both inside the WMA C area and outside the WMA. You are going to need to piece together a story of how events or potential events evolved providing sufficient details. Some readers may be very familiar with the complex groundwater events and actions, more so than I, but only a few. The reader should not have to find information in order to understand your statements and evaluate them. Thus, summary information and tables on the details of the contaminants, their flow and migration, as			

		well as your interpretation is required. I note the summary of borehole C4297 (section 5.1.2) is a good example of providing concise text summary of the information from the PNNL report 15503. I strongly suggest that more detailed and up to date plume maps for technetium-99, nitrate, sulfate, and iodine-129 are necessary as well as the tabulated groundwater data to provide the reader with sufficient information to follow your story.			
21.	Data Gaps 8.2.3	Ecology takes a broader view of further information needs to complete an investigation into the nature, extent, and pathway(s) of contamination at WMA C. Tank retrievals will continue for some time (C-102, C-105 and C-111) are not done. Completion of these tank retrievals, sampling, and reaching a decision that no more tank retrievals are necessary will take considerable time and extend well past December 31, 2016 date for the final RFI submittal. Ecology, thus has concerns about the areas defined below; that will require discussion, evaluation, and potentially much more information. 1. Disconnect between known leaks within WMA C and the high TC-99 at perimeter wells 2. Investigate the Nez Perce idea that C-105 and C-108 had previously leaked (presented in the WMA C PA) over 100 Ci of Tc-99 3. The information on contamination in the ancillary equipment is incomplete at this point in time. 4. Investigate 30-08-02 and possible leak of C-108 during retrieval Cobalt and cesium both showed movement in the latest well logging. The cesium movement could be explained by a leak of sodium hydroxide during the hard heel retrieval of tank C-108. 18M sodium hydroxide was used for dissolution of the aluminum heel. 5. Confirm no leaks at C200s during retrieval No leak detection was available or employed during retrieval of all four of these tanks; only a crude water mass balance was used. Ecology may want to confirm no additional constituents of concern were added to WMA C soils here as well as investigate leaks from the C200 tanks and/or pipelines during operational days. 6. Two possible leak scenarios from tank C-101 are given in the leak loss evaluation; a small leak of waste from the tank or a larger volume of waste diluted with condensate. 7. Site L1 Tc99 was found at bottom of the hole at 135 feet; the drill string broke and decision was			

		made to sample at depth. Could more Tc-99 be below this site? 8. Proposed in the plan was an idea to run SGE around the perimeter of what would be defined the cap perimeter area. This would/could be done in the final closure process/evaluation but would like to mention it here as a data gap. 9. The Nez Perce have suggested a push hole twinning groundwater wells E27-7 and E27-14 to sample and evaluate soil contamination found in drilling the original wells.			
22.	Appendix X	Table X-1 and other tables I do not understand the information it is presenting. What is it trying to tell me??			

REVIEW COMMENT RECORD	Date	Review No.
	Project No.	Page Page 1 of 22

Document Number(s)/Title(s)	Program/Project/Building Number	Reviewer	Organization/Group	Location/Phone
RPP-RPT-58339, Phase 2 RFI WMA-C, Rev. A Draft	NWP - TSOC	Joe Caggiano 372-7915	WA Dept of Ecology	Mike Barnes - Lead 372-7927

Comment Submittal Approval: Agreement with indicated comment disposition(s) Status:

Organization Manager (Optional) Date

Reviewer/Point of Contact Date

Author/Originator

Reviewer/Point of Contact

Author/Originator

Item	Page #/section # Line #	Comment (s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/ problem indicated.)	Hold Point	Disposition (Provide justification if NOT accepted.)	Status
1.	General Comment	This document is huge and is written by several authors, with little cross referencing of topics. Thus, a single topic (e.g., recharge, groundwater) is discussed in various levels of detail in several sections and appendices, but with no cross referencing. This has led to comments of inadequacy regarding content in one section that might be found somewhere else. This document needs a good technical edit and a crosswalk of some kind. Better yet, combine material so that it all appears in one place, with reference to other places where related information/data can be found. Hot links to important references would be very useful. When referencing huge documents, please provide the specific pages/sections where the pertinent			

		material may be found. The Adobe reader search engine is of little value in this regard. Please implement.				
2.	General Comment	An objective of this report in support of the PA and closure ought to be to account for the estimated volume/mass of contaminant inventory released and where it is currently located in space. The estimated volume of releases from tanks and ancillary equipment should be accounted for; i.e., is it in the vadose zone or the groundwater, or did it reach groundwater and has since moved downgradient. The estimated inventories in groundwater and the vadose zone are less than the estimated release volumes. So where is this inventory? Is it in the deeper vadose zone that continues to "bleed" contaminants into groundwater? Is it in the deeper part of the unconfined aquifer that hasn't been adequately characterized? Or is it elsewhere? This should be a program objective. Please include the search for this information in future plans of investigation.				
3.	General Comment	Please clearly define and delineate the area/volume that will constitute WMA C and for which this RFI is intended. As there are waste sites and UPRs outside the perimeter fence and maps show a much larger area of investigation for the CMS, we need a clear definition and delineation of what WMA C is. This will be important in determining the footprint of any closure barrier. Please provide.				
4.	General Comment	The RFI is intended to provide the data for which the CMS will identify potential corrective measures. For a RCRA RFI, the report should identify the				

		magnitude and extent of all media contaminated by releases from the facility. For groundwater, that information is not provided. DOE, as the owner/operator, is responsible to provide that data, even if that work scope is fragmented into different work scopes for different organizations/contractors. Please provide.			
5.	Pg. 1-1, Fig. 1-1	This figure is a graphical depiction of the characterization for soils only. Where is the one for groundwater which is one of the media affected by releases from WMA C? Please include.			
6.	Pg. 1-2, Lines 5 – 9.	As the TWEIS has already determined that wastes will be left in place and a work plan will be developed to characterize the releases, then why is this statement even present in this document here? Furthermore, it is known that there are SST contaminants from WMA C in the soil and groundwater, so assessing the need for corrective measures is moot. Please re-think and revise this document.			
7.	Pg. 1-2, lines 17 – 19.	This statement is incorrect, as drywell logging has been performed since the 1970s in C Farm. None of that information is here. Drywell logging could identify release dates and/or migration of contaminants, including non-gamma emitting radionuclides and dangerous waste chemicals. Please include that information and correct this omission.			
8.	Pg. 1-9, Sect. 1.1.3	A statement should be made that groundwater monitoring was not conducted during operation of C Farm which ceased operating in 1980 or earlier. Groundwater monitoring began in 1989 with installation of 4 wells. No groundwater monitoring wells were present during operation of C Farm. A			

		single well was installed in 1982 (299-E27-7) which doesn't satisfy RCRA groundwater monitoring requirements. Please add.				
9.	Pg. 1-9, Sect. 1.1.3	WMA C is located above the 200-BP-5 groundwater operable unit, the schedule for which does not coordinate with the planned date of closure of WMA C. If 200-BP-5 closure extends past the closure date for WMA C, then DOE must provide data and corrective action work plans in the CMS to bridge this gap and to fully comply with the requirements for TSD units in WAC 173-303-610, WA HWMA, and RCRA closure requirements for action on groundwater contaminated by WMA C. Please provide.				
10.	Pg. 1-9, lines 39 – 41	Inadequate. This RFI is to provide data needed to evaluate corrective measures in the CMS for groundwater contaminated by releases from WMA C. Please provide the required data on magnitude and extent of groundwater contaminated by WMA C.				
11.	Pg. 2-8, lines 35-37	I suggest explaining the purpose of interim-stabilization; i.e., to remove liquids from the SSTs to minimize leak potential. Please consider.				
12.	Pg. 2-11, lines 41-45.	Much of the BWIP research was focused on suitability of the Columbia River basalts to host a high-level nuclear waste repository, which included characterizing the various basalt stratigraphic units and the behavior of the confined aquifer system within the basalts. Previous waste management activities characterized the supra-basalt geology, with focus on its suitability for waste management activities. Please consider.				
13.	Pg. 2-18, lines	The varying grain sizes of strata/lamina within the				

	26 - 28	Hanford fm. create significant heterogeneity that leads to lateral flow. This heterogeneity results in lateral flow that leads to a "stair step" process of infiltration of natural precipitation or any artificial recharge. Please discuss this heterogeneity and the anisotropic flow phenomena within the vadose zone. Please add.			
14.	Pg. 2-19, Fig 2-6	This caption is misleading. What about the drywell/French drains located in and around WMA C? Liquids of varying quantities and compositions were discharged to these facilities, although the volume may have been small. Please correct this figure.			
15.	Section 2.3.5	This section discusses natural recharge only. What about all the sources of artificial recharge that in total added significantly more recharge than natural precipitation? This artificial recharge has had a significant effect on driving contaminants to groundwater. Please include.			
16.	Pg. 2-23, lines 17-26.	No mention is made of the plume in groundwater beneath WMA C arising from releases from this facility. Please include.			
17.	Pg. 2-23, lines 1-4.	CHPRC may be the contractor that monitors and characterizes groundwater, but the magnitude and extent of releases to groundwater from WMA C should be in this report, regardless of which contractor is responsible. It is the responsibility of DOE, as the owner/operator, to provide needed data on the contaminants and their spatial distribution in the vadose and saturated zones that have arisen from WMA C. Please correct.			
18.	Pg. 2-31, lines	This statement is not entirely true. Correlation and			

	1-3.	comparison of the elevation of high-moisture zones provide evidence of the possible correlation and the effect of these finer lamina/lenses on fluid flow through the vadose zone. These contribute to significant lateral flow that must be addressed. Please correct.				
19.	Pg. 2-34, lines 41-46.	If there are six events that have been documented since 1979, one could surmise that more events occurred between 1945 and 1979 that were undocumented but have the potential to add still further contaminant-driving force to the vadose zone. Please address.				
20.	Pg. 2-35, lines 1 – 7.	Most drywells, to this day, have no annular seals, but a few around T Farm have a second casing. Care was not common prior to ~2000 to assure that drywells were immediately capped after each use. Open drywells provide a conduit for floodwaters to infiltrate deeper into the vadose zone. Also, most drywells are open at the bottom; only a few have a concrete plug at the base. Please add.				
21.	Section 2.4.5.	When surface contaminant spills/releases occurred during operations, water was often added to the soil to "wash down the contaminants" to make the site safe for workers to occupy. Please add.				
22.	Pg. 2-39, Table 2-1	These are the documented incidents. Makes one wonder how many might have occurred during operations that were never documented. Please consider.				
23.	General Comment on Section 3.	In a couple of places, drywells and/or French drains are mentioned, but there is no location or description of the volume and types of contaminants discharged to them (e.g., from Cs Loadout facility). These are likely constructed differently from the "conventional drywells" used for geophysical				

		logging around C Farm tanks. Please add something about their construction design and operating history.			
24.	Pg. 3-1, lines 31-46.	These statements imply that WMA C is only the area within the tank farm security fence. The fence line is a security construct only to limit access to the actual farm. It is not necessarily the area inside the perimeter fence, as shown by your maps that show a much larger study area that will be investigated for the CMS and closure. Please define what exactly is WMA C for closure and justify this designation.			
25.	Pg. 3-4, lines 24, 25	As written, this sentence implies that there is a cascade line between ALL tanks (e.g., C-103-104). Each tank in a cascade of 3 tanks has a cascade line running between the tanks. Please correct.			
26.	Pg. 3-5, lines 1-10.	It would probably be pertinent to state that the spare inlets for all these tanks had varying quality seals, ranging from force-fit wooden plugs to better quality seals. These poor quality seals contributed to releases for overfilled tanks. Please add.			
27.	Pg. 5-1, 3-5.	The purpose of this section is to provide the nature and extent of ALL media contaminated by releases from the facility, including groundwater. The magnitude and extent of groundwater contamination needs to be provided, not just some groundwater "facts". That information is needed either here or in an appendix. Please provide.			
28. Pg. 1-8, bullet 2	Pg. 1-8, bullet 2	As written, this statement implies that reclassification of residual tank waste as LAW, regardless of content and mass, is a foregone conclusion to facilitate closure. While this work may support the WIR evaluation process, it should not be construed as supporting an already-done and foregone conclusion. Please clarify, discuss or			

		delete.				
29.	Pg. 6-2, Lines 1-17	RCRA does not distinguish between primary and secondary sources. A RCRA TSD facility includes the facility, the waste therein, and ALL media contaminated by releases from the facility. Using the term,"Secondary Sources", implies that these are less important to consider in the CMS and will not be treated the same. If these "Secondary Sources" are ancillary equipment, then they are part of the SST system and must be treated on equal footing with all other sources in the SST system. Please either explain or delete the use of this term and this concept.				
30.	Pg. 9, Table 6-1.	For the Post-Institutional Control Period, please define what the "Facility" is for clarity. Is it the area under any barrier? Or something else? Please clarify. Also, explain whether "Water Resources" in this table includes groundwater. If not, then specify these points of assessment for groundwater.				
31.	Pg. 6-4, lines 38-44.	This section discusses "anticipated closure actions." Other than landfill closure, these closure actions haven't been addressed, but presumably will under the CMS. Will these be factored back into the C Farm IPA? Please clarify.				
32.	Pg. 6-6, Sect. 6.2.2.2	Is the plane 100 m downgradient from the facility the only compliance point that will be used for both hazardous and radioactive waste contaminants in groundwater? If not, what other compliance point(s) will be used and will these comply with the RCRA POC? Please clarify.				
33.	Pg. 6-6, Sect. 6.2.2.3	What about a time period equal to the time it takes for the longest-lived isotope and/or waste to reach peak concentration? Is this being considered? Please clarify.				

34.	Pg. 6-9, Alternative Conceptual Models.	Some mention should be made that at least one additional conceptual model considering the heterogeneity of the stratigraphy is being investigated and will be incorporated in the site analyses should it be deemed significant after investigation. Please add.			
35.	Pg. 6-9, Lines 29-44.	How will these analyses be run if characterization to date hasn't found high levels of contamination in the shallow vadose and none in the deep vadose zone? The same could be said for preferential pathways. Please explain how these analyses will be done.			
36.	Pg. 6-19, line s21-22	This sentence should be modified to indicate that poor or no annular seals could lead to open spaces between the casing and formation which could accelerate vertical movement of fluids. Please clarify.			
37.	Pg. 6-18, Lines 6-8.	Will these be used to approximate the contaminants and the timing of their arrival in groundwater to the extent possible? Please clarify.			
38.	Pg. 6-18, lines 18-21	Will this include the heterogeneities within the stratigraphic column with WMA C and their effects on lateral spread of infiltrating contaminants? Please clarify.			
39.	Pg. 6-20, Source Term Inventory	The only dangerous waste mentioned is Cr. How are other radionuclides and dangerous wastes being considered? Please clarify.			
40.	Pg. 6-21, Table 6-2.	Are these estimates based on sampling results from residuals and assuming a final waste inventory of 360 cu. ft? Are they final residual inventory estimates? What about tanks that have yet to be retrieved; is a default 360 cu. ft. being used? Please clarify.			
41.	Pg. 6-23, Lines	Does an "inactive node" mean that the properties of			

	38-43.	these nodes remains constant during the analyses, or something else? Do they contribute to the analyses? Please clarify.				
42.	Pg. 6-25, lines 7,8.	I assume that this language means that the sloping top of basalt is a vertical no flow boundary. If true, could you clarify this? Please consider.				
43.	Pg. 6-25, lines1 – 18	Please justify the flux assumptions made in the WMA C model.				
44.	Pg. 6-26, Sect. 6.5.2	No mention is made of two other possible conceptual models that may be run pending the outcome of model development and sensitivity studies. 1) An artificial recharge model to account for the various methods of adding water to the ground other than natural recharge, and 2) A model that will be used to evaluate the effect of heterogeneities within the vadose zone and their effect on flow and transport. To not include them is to pre-judge each as inconsequential. Please include				
45.	Pgs. 6-29 and 6-31.	Is this discretization fine enough in the z direction to permit the meaningful evaluation of silty strata and the effects of these heterogeneities on flow and transport? And if so, how will the parameters to populate these cells be selected? Please address.				
46.	Pg 6-33, lines 6-8.	Justify or delete this statement. With all the uncertainty, this to me is an unjustified label. Please correct.				
47.	Sect. 6.5.5.1	No mention is made of the volume of artificial recharge added to the soil by various means that served to accelerate the drive of contaminants to groundwater or deeper into the vadose zone. This will be needed for sensitivity cases for scenarios of different recharge rates during operations. Please provide.				

48.	Pg. 6-37, lines 23-30	Given the experience with recharge on the side slopes of the prototypical Hanford barrier (over the B-57 crib), justify the statement that the impact of the side slopes on recharge is relatively minor. Please explain and justify.			
49.	Pg. 6-37, lines 1-2	Design of a barrier can't progress without identifying the area to be covered (i.e., the footprint of the barrier). If this is to be in the CMS report, then that information should be present and isn't. Please comment.			
50.	Pg. 6-42, Table 6-10	Please provide the transverse dispersivity to be used in the Denominator Case modeling for WMA C.			
51.	Pg. 6-46, Table 6-12.	Several contaminants have already arrived in groundwater in 50 years, indicating that these assumptions of Kd or the amount of recharge are incorrect. Please address.			
52.	Pg. 5-1, lines 10-12.	There are multiple high-level waste streams emanating from the various spent-fuel reprocessing operations. What specific waste stream was being moved when this release occurred? Please elaborate and also what other constituents might have been present in significant quantities in this waste stream.			
53.	Pg. 5-6, bullets.	CN is present in groundwater, but is not on this list of constituents at this or other sites. Did it show in any of the analyses of these samples? Please add.			
54.	Pg. 5-6, line 10.	If pH is an indicator of past waste, what constituents would be associated with this zone for inventory estimates if there are no specific constituents associated within this zone? Please address.			
55.	Pg. 5-7, lines 22-27	Any guestimates as to why Ca is so high in this zone? Also, what might be the source of the elevated Cl? Please address.			
56.	Pg. 5-8, lines 4-	Why is the Na so high? Is there evidence of cation			

	11.	exchange in certain locations in C Farm soils? Please address.				
57.	Pg. 5-8, lines 25-30.	Tc-99 is present in groundwater, but is not present here. What are the likely sources of Tc-99 in the vadose zone? Please address.				
58.	Pg. 5-11, lines 35, 36.	The absence of Cs-137 which is generally ubiquitous in C Farm and the absence of Co-60 are curious. Any thoughts on why this is and what it means for flow and transport? Please address.				
59.	Pg. 5-12, lines 41-43.	Are these the correct units of measure for Tc-99? Please check and correct as needed.				
60.	Pg. 5-14, line 22.	CN is present in groundwater, but it was not detected in any Phase 2 samples. Has it been detected in any soil analyses? Please address.				
61.	General Comment	Bulleted analyses results might be better presented and easier to compare if they were compiled in tabular or graphic form (i.e., strip logs). Please consider.				
62.	Pg. 5-63, line 40.	What is meant by "rapid-scan gamma surveys"? Does this refer to rate of withdrawal from the hole or something else? Does this reduce detection limit for various radionuclide species? Please clarify.				
63.	General Comment	Whenever you discuss geophysical logging, you should specify the tool, the withdrawal rate, and the detection limit for the various species. Or at least somewhere in the document. Please consider.				
64.	General Comment—Geophysical logging	For logs that are not readily accessible online, please include the logs (e.g., C4297 and all the logging done at the lettered sites) or a link to the logs. A graphic is preferred to bulleted summary descriptions.				
65.	General Comment	There ought to be a rationale for selecting the various sites that were investigated; i.e., why this locale and not somewhere else? Known release				

		sites? HRR/SGE? Or? Please include.			
66.	General Comment	As an overview, there ought to be an estimated inventory potentially released to the soil from tanks and other sources (with appropriate uncertainties) and the currently known/estimated mass of contaminants in the vadose zone and groundwater. If these do not agree within appropriate limits, then there ought to be an explanation of where the released inventory might be and how characterization activities will be planned to determine the means to characterize/search for the missing inventory. This would be a good introduction to justify the investigations. Please consider.			
67.	Pg. 5-98, Sect. 5.3.4	The concentration/activity in the various waste streams differ. Potential for detection is affected by both the volume and concentration/activity. Please clarify.			
68.	Pg. 5-100, Fig. 5-23	On page 5-98, you indicate that C-101, 104 and 108 are the largest "known release" sites. Then, why does the maximum resistivity anomaly show around C-104 only? And why was an initial anomaly under C-104 and then, with further processing of the data, mapped under C-101? How does one know what to believe when "further processing" of the data cause the anomalies to shift to a new location? Doesn't this suggest that the technique, while promising, hasn't lived up to its potential when "ground truthing" is done via bore- and push holes? As a planning tool, it seems to be invalid. Please explain.			
69.	Pg. 5-105, Fig. 5-27.	There are known pipeline releases between C-105 and C-105, and the maximum Cs-137 in drywell 30-05-07 does not show as an anomaly. Please			

		explain.			
70.	Pg. 5-106, lines 9-10.	These 12 wells have different screen length, placements and locations relative to the water table. Please clarify this information for each of the 12 wells.			
71.	Pg. 5-106, lines 28-31. Pg. 5-106, lines 39-43.	The RFI is intended to supply the data that will be used in the CMS, not a supplemental screening level or a general discussion of groundwater. Please include.			
72.	Pg. 5-108, Table 5-8.	CN is a contaminant of interest for WMA C because it is found in several C Farm monitoring wells. As the source seems to be WMA C, please identify the specific source and/or plans to locate/identify the specific source source.			
73.	Pg. 5-110, Sect. 5.4.1.2	NO3 is said to be dispersed throughout the saturated unconfined aquifer based on the depth of occurrence in a few wells. If it is dispersed from top to bottom throughout the unconfined aquifer, what are the plans for installing more deep monitoring wells to see how it is distributed near the tank farm proper, as well as the vertical distribution of all contaminants throughout the aquifer? Please include.			
74.	Pg. 5-111, Sect. 5.4.1.3	The presence of SO4 migrating into WMA C suggests more than just other waste management facilities. Pyrite is present as an accessory mineral in the basalt. Is there a hydraulic connection to flows in the basalt that contain pyrite? Please address.			
75.	Pg. 5-111, Sect. 5.4.1.4	Please provide the specific basis for assuming that Ni is coming from dissolution/corrosion of carbon steel well casings.			
76.	Sect. 5.4, General	Somewhere in this section, it should be stated that the first groundwater monitoring well at WMA C			

	Comment	was installed in 1982, and that a network wasn't complete until 1989. Thus, there was no groundwater monitoring at this site during the years of operation from 1945 until 1980. Please include.			
77.	Pg. 5-122, footnote.	Drywell logging detects gamma emitting radionuclides only. Tc-99 is a beta emitter and will NEVER be detected in any cased borehole. Please revise this footnote.			
78.	Pg. 5-133, Table 5-13	It would useful to add another row to this table to provide the total estimated release inventories for each constituent/site and the uncertainty. Please include.			
79.	Pg. 2-22, Fig. 2-8.	This map shows groundwater flow through Gable Gap. This has occurred in the past during operations when the water table was higher than at present. Since ~2011, it appears flow no longer occurs through Gable Gap and that the Gable Mt. structure is now a groundwater divide. Please correct as appropriate. A more recent water table map may make this point clearer.			
80.	Pg. 2-39, Table 2-1.	These are likely only a few of the documented water line releases in and around C Farm. These water lines likely experience at least a 10% chronic leak loss during their use. A draft report for BWIP estimated upwards of a 30% loss of raw water delivered to the 200 East Area. Considering the diameter of these pipes and the pressure maintained within, some estimate needs to be made to account for the arrival of C Farm contaminants within a 50 year period. Please discuss.			
81.	Pg. 6-3, Sect. 6.3	There is no mention here or in Section 2 of the extreme heterogeneity in the vadose zone that is currently being investigated as to its potential effect on infiltrating fluids and contaminants in the WMA			

		C vadose zone. Sounds like this investigation is not being treated seriously. Please include.				
82.	Pg. 6-9, lines 7-9.	While all these alternatives may be partial contributors, in reality, all these elements may have contributed in some composite "model". Will this be investigated in addition to the separate effects of each alternate? Is this all part of Section 6.4? Please address.				
83.	Pg. 6-19, lines 34-39.	Where is the contaminant inventory, areal and vertical extent, and depth distribution of groundwater contaminants? Will this be in the next revision of this RFI? Please address.				
84.	Pg. 6-20, Groundwater Domain	Where is the information/data on the areal and vertical extent of the groundwater contaminant plumes? Please include.				
85.	Pg. 6-23, Sect. 6.5.1	Please describe the process you will use to populate these various cells with data. Will it be actual field data, assumptions with uncertainties, Monte Carlo simulations where data are insufficient? Please include.				
86.	Pg. 6-36, Table 6-6.	These are presumably natural recharge rates which are fine for pre- and post-operational time periods, but artificial recharge estimates during site operations need to be factored in, as these may have been orders of magnitude greater than natural recharge. Please discuss.				
87.	Pg. 6-37, lines 14-21.	One scenario I would suggest evaluating is one where the designed closure barrier does not function for as long as is assumed; i.e., useful life of say 200 or 300 years. Please consider.				
88.	Pg. 6-40, lines 20-22.	Define what is meant by the "vertical anisotropy ratio of 0.1". Are you saying that the vertical flow is estimated to be ~300 m/d, or ??? Please clarify.				
89.	Pg. 6-43, Sect.	The magnitude and extent (plume volume) of				

	6.6.1.2	contaminants needed to do a PA is what is required in an RFI to enable and inform the CMS. A screening level is only the beginning. When will this information be included in this RFI report? Please address.			
90.	Pg. 6-44, bullet 2.	While I understand why these constituents would not be included in estimating future PA results, they do provide useful information (where known) about the possible location of release points and the areal and vertical extent of non-gamma and dangerous waste constituents. Please elaborate on this discussion to provide a more complete description.			
91.	Pg. 6-44, lines 35-37.	What is the basis for this statement? If it's based only on estimated natural recharge, then it may not be true considering the enhanced artificial recharge during site operations. Please provide the basis for this statement.			
92.	Pg. 6-45, Table 6-11	I would suggest you use variable recharge rates for the operational period until you can approximate an estimated arrival time of arrival of mobile constituents in groundwater that approximates actual site history. Please discuss.			
93.	Pg. 6-46, lines 1-8.	What is the location of any receptor in this evaluation? For a RCRA TSD facility, the point of compliance is a vertical plane at the downgradient margin of the facility. Please elaborate where you are making this claim.			
94.	Pg. 8, lines 3 - 8	The nature and extent of soil contamination in WMA C was a target for this RFI report, but the report misses the target. Furthermore, the groundwater information is superficial and a "preliminary overview", but the data needed are absent. Section 8.2.3, intended to identify data			

		gaps, states information to justify why no further characterization is needed at several facilities. With all the discussions we have had regarding the scope and content of this document, it is frustrating to find much of the needed data/information is lacking. Please provide the information/data you agreed to provide in a format that is easy to read, that includes such things as geophysical logs, estimated volume of soil and groundwater plumes, identification of data gaps, and a path forward for acquiring the missing data/information.				
95.	Pg. 8-2, lines 3-6.	Justify these statements in light of the fact that groundwater from WMA C and other SST WMAs was known to have been contaminated by releases from WMA C. Please address and also whether this bias continues.				
96.	Pg. 8-2, lines 1-2	Given the degree of anisotropy and heterogeneity that exists in the glaciofluvial sediments of the vadose zone, please justify this statement.				
97.	Pg. 8-2, lines 4-13.	In light of the fact that Tc-99 has been in the groundwater under WMA C for at least a decade, justify this statement.				
98.	Pg. 8-2, lines 29 – 30.	This statement needs to be qualified to state that sampling was depth limited to ~ 160 ft. and did not extend all the way to groundwater. Please address.				
99.	Pg. 8-2, lines 40-43.	This statement conflicts with statements given on pg. 8-1 that transport was assumed to be predominantly vertical. Please clarify.				
100.	Pg. 8-4, lines 1-4.	This statement implies that you know the depth of effectiveness of a store-release (or any other) type of surface barrier; and also that you have estimated the area to be covered by a barrier. Please explain/justify these statements.				
101.	Pg. 8-4, lines 6-	Groundwater contamination arising from WMA C				

	9.	is still the responsibility of DOE (the owner/operator) and must be dealt with on the schedule for closure of WMA C. The schedule for 200-BP-5 is out of sync with most source facilities in the area underlain by BP-5. Furthermore, no decisions have been made as to the remedial measures to be implemented for BP-5. Furthermore, the scale of WMA C and the 200-BP-5 groundwater operable unit are considerably different. At the BP-5 scale, e.g., remediation of CN released from WMA C might not be a controlling obligation. Please provide the needed information.			
102.	Pg. 8-4, lines 13-29.	The volume of soil beneath all tanks is essentially unknown and presents a data gap that needs to be filled with further characterization, or some assumptions must be made in developing the CMS about areas/volumes where contamination may be present. This statement also applies the deep vadose zone. Please address.			
103.	Pg. 8-4, line 24.	Explain what assumptions may be made in the IPA if characterization of this release site (C-105) is not possible.			
104.	Pg. 8-4, lines 38-39.	No mention was made of retrieving the waste from the C-301 catch tank. Is this being considered? Please clarify and explain why no further characterization is needed.			
105.	Pg. 8-5, lines 6-10.	You have none to very limited data/information on the deep vadose zone below ~150 ft. Contaminants at this depth will continue to drain to groundwater. Given this information as well as lack of characterization data/information on the deep aquifer, justify these statements.			
106.	Pg. 8-5, lines 15-21.	These statements need justification. Furthermore, they provide little basis for proceeding to a CMS.			

		To be able to propose corrective measures in the CMS, one should know the areal and vertical extent of contaminated soil. Please explain and justify these statements.				
107.	Section 9 General Comment	This is a huge reference list. What might make it more usable is some organization by general topics, such as DOE, Regulatory, and Technical. Another suggestion might be to make it searchable, or provide hot links in the document itself. Please consider.				
108.	Appendix E, p. E-1, lines 10-11	Where was the 221-C plant to be located? What happened to the open hole that had been excavated? What is the current status at that location? Was any piping installed from the location to C Farm? Please clarify.				
109.	Appendix E, Table E-1.	Nice table. It would be helpful to elucidate the differences in composition and concentration/activity for each of these waste types. Waste chemistry and physical properties strongly influence the soil/waste interaction and thus affect its migration through the soil once released. Not all wastes are equal. Please include.				
110.	Appendix U	Great information on these time series plots for various constituents in various wells, but incomplete. What is the interpreted volume of contaminated soil and contaminated groundwater that you will use for planning and identifying potential corrective measure studies in the CMS analysis? Please provide.				
111.	Appendix X	Great information, but how is this distributed in the vadose; how do the concentrations/activities vary with horizontal and vertical distance? The total volume of contaminated soil and its distribution is needed for PA and BRA modeling as well as for				

		planning for corrective measures for the CMS. Please provide.			
112.	Appendix S General Comment	There are a lot of tables and graphics discussing the SGL logging programs, but there are no actual logs which would seem to be a simpler and more direct presentation of the information. Tabulating and illustrating "shallow" and "deep" information seems a lengthy and verbose way of presenting the information. I think the reader is intelligent enough to understand the actual logs if they are reading this section. Please consider including the actual logs.			
113.	Appendix S General Comment	Why is there no information from historical logs? They provide information on approximate time of release and arrival at a drywell as well as indicate depths where gamma-emitting radionuclides were once present (and thus other radionuclides and dangerous wastes were also released). Please include, or at least discuss. There aren't references or links to the historical logs.			
114.	Appendix U Fig Q-11	Is this total Cr? Is any of this Cr+6? Please clarify.			
115.	Appendix U General Comment	In the contaminant distribution profiles, certain constituents show only one dot, whether detect or non-detect. Does this mean that only one sample from the selected depth was analyzed? If so, justify the basis for sampling only at the selected single depth. Please clarify.			
116.	Appendix U, soil/contaminant profiles	For some constituents, the analysis method is clear from the reporting units. For others, the results could be from spectral gamma logging and/or sample data in some combination (e.g., averaging). Please clarify the source of the data as to sample, log, or other means. I have seen data from different methods differ by an order of magnitude. In such a			

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		case, how does one choose?				
117.	Appendix W General Comment	Good information, but again no logs. Please include.				
118.	Appendix X General Comment	Good information, but it includes estimated inventory released from tanks, both graphically and in tabular form; however, there is no indication of the vertical and/or lateral extent of this inventory for the various constituents released. Please provide, as this information is needed for the CMS and closure.				
119.	Appendix E, Table E-1	Metal waste is omitted from this table, but it is on the timeline for at least one tank in timelines that follow this table. Please correct this table.				
120.						
121.						

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Document Number(s)/Title(s) RPP-RPT-58339, Phase 2 RFI WMA-C Rev. A Draft	Program/Project/Building Number NWP - TSOC	Reviewer Damon	Organization/Group WA Dept of Ecology	Location/Phone Mike Barnes - Lead 372-7927

Comment Submittal Approval: Agreement with indicated comment disposition(s) Status:

Organization Manager (Optional) Date

Reviewer/Point of Contact Date

Author/Originator

Reviewer/Point of Contact

Author/Originator

Item	Page (P), Section (S), Line (L)	Comment (s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/ problem indicated.)	Hold Point	Disposition (Provide justification if NOT accepted.)	Status
1.	Section 7, general comment	Transparency is compromised by fragmenting or repeating information in multiple documents (RPP-RPT-58339; RPP-RPT-58329; RPP-RPT-58297; DOE/RL-2009-127).			
2.	P 7-1, S 7.0, L 9-19	Text states, "A high level groundwater screening evaluation was performed as part of the baseline risk assessment (RPP-RPT-58329)….." However, it is unclear if this "high level groundwater screening evaluation" should actually refer to RPP-RPT-58297 (rather than RPP-RPT-58329). Furthermore, text states, "A quantitative baseline risk assessment and evaluation of remedial alternatives for the groundwater underlying the WMA C area of interest is evaluated within the 200-BP-5 groundwater OU remedial investigation/feasibility study (DOE/RL-2009-127, *Remedial Investigation/Feasibility Study for the 200-BP-5 Groundwater Operable Unit).*" This fragmentation of the groundwater evaluation in multiple documents obstructs integration of risk assessment in WMA C. At the very least, a "document map" should be provided to clarify where all risk assessment components for WMA C are published, and a description should be provided to explain how all risk pathways will be integrated.			

3.	P 7-1, S 7.0, L 24	The groundwater screening evaluation is in Section 7.7 (not 7.4).			
4.	P 7-5, S 7.1, L 1-8	In addition to the MTCA point of compliance (POC) for direct contact, note that the MTCA POC for groundwater protection is throughout the vadose zone (surface to groundwater) (WAC 173-340-740[6][b]).			
5.	P 7-5, S 7.2, L 38	In general, HHRA (per EPA guidance) is broader than MTCA (WAC 173-340). For example, HHRA includes terrestrial foodchain pathways, whereas MTCA does not.			
6.	P 7-6, S 7.2.1.1, L 18	Text describes one COPC exclusion criteria as, "Analytes without known toxicity data information." This exclusion should be described as an uncertainty. A recent editorial in Toxicol Sci notes, "Surprisingly, the current model deems that if we have no reliable toxicity data for a given chemical then it must be assumed to be safe. Although we may be blissfully ignorant of the toxicity this could indeed be very dangerous for the health of the human race and for the planet" (Miller, 2015) (http://toxsci.oxfordjournals.org/content/early/2015/02/25/toxsci.kfu310.full.pdf).			
7.	P 7-6, S 7.2.2.1, L 41	Text lists, "an environmental transport medium," as required for a complete exposure pathway. Note that this component is not needed for external radiation.			
8.	P 7-8, Figure 7-3	In addition to soil ingestion and soil inhalation, MTCA (WAC 173-340) includes soil dermal contact and soil contaminants leaching to groundwater with subsequent ingestion by residential receptors. Also, CERCLA includes soil contaminants leaching to groundwater with subsequent ingestion by residential and tribal receptors or other subsequent uses (e.g., showering, irrigation of crops). Perhaps an intruder driller (accessing groundwater) should be included too. Contaminated groundwater may also impact fish in the Columbia River which may be consumed by residential or tribal receptors.			
9.	P 7-9, S 7.2.2.1, L 5	"(EPA 2012)" is not listed in the references in Section 9.			
10.	P 7-9, S 7.2.2.1, L 26	"Inhalation of vapors and dust in ambient air" should be changed to "Inhalation of vapors and dust in ambient air, originating from soil."			
11.	P 7-10, S 7.2.2.1, L 44-46	Text notes that consumption of fruits/vegetables/grains, meat, and milk are only applicable to rad COPCs for the CERCLA resident receptor. Nonrad COPCs should also be included here for these food ingestion pathways.			
12.	P 7-11, S	For EPC selection rationale, text refers to Figure 3-2 in the BRA (RPP-RPT-58329).			

	7.2.2.2, L 35	This figure recommends the max in cases where 95UCL is not calculated, 95UCL>max and Chebyshev UCL is not calculated, and Chebyshev UCL>max. However, ProUCL (version 5.0) states, "It is recommended not to use the maximum observed value to estimate the EPC term representing the average exposure contracted by an individual over an EA. For the sake of interested users, ProUCL displays a warning message when the recommended 95% UCL (e.g., Hall's bootstrap UCL) of the mean exceeds the observed maximum concentration. For such scenarios (when a 95% UCL does exceed the maximum observed value), an alternative 95% UCL computation method based upon Chebyshev inequality is recommended by the ProUCL software." Therefore, when possible, a 95UCL should be calculated to represent EPC. Only in cases where UCL cannot be not calculated (i.e., statistical analysis is not appropriate or not possible) should EPC defer to the observed max, noting the uncertainty in EPC. Exceptions where defaulting to max is allowed might include small sample sizes (e.g., n<5), low frequency of detection (e.g., <20%), or focused sampling. Ecology has made this comment repeatedly.			
13.	P 7-13, S 7.2.3.1, L 17-19	According to OSWER 9285.7-53, all sources for toxicity values that are not Tier 1 or Tier 2 fall into Tier 3 by definition. Therefore, NCEA/RAIS comprise Tier 3 toxicity values.			
14.	P 7-13, S 7.2.3.1, L 26-27	Units for risk coefficients for internal exposure are [risk/pCi].			
15.	P 7-15, S 7.2.4.1, L 15-17	Considering that a background risk assessment was performed for soil nonrads, explain why a corresponding background risk assessment was not performed for rads (using Hanford soil background data for rads).			
16.	P 7-15, S 7.2.4.2, L 28-34; P 7-17, S 7.2.5.2, L 2-3	The MTCA Method C standard for cumulative site risk is 1E-5 (not 1E-6). Also, the text identifies two risk limits for nonrads for major risk contributors (1E-6 and 1E-7). Please clarify.			
17.	P 7-17, S 7.2.5.2, L	Text notes that because As background ELCR (2E-6) was greater than or equal to As Exposure Area (EA) ELCRs, As was retained. However, As should be eliminated if			

	4-5	background ELCR exceeds EA ELCR.			
18.	P 7-20, S 7.2.5.6, L 14-15	WAC 173-340-745 applies to industrial soils but not to a "youth trespasser exposure scenario" (MTCA Method C exposure parameters are not compatible with intermittent exposure and a youth receptor).			
19.	P 7-21, S 7.2.5.7, L 1-3	Text identifying EAs with ELCR>1E-5 for nonrads does not match up with Table 7-8 data (child or adult).			
20.	P 7-23, S 7.2.5.8, L 2	Text identifying EAs with ELCR>1E-5 does not match up with Table 7-9 data.			
21.	P 7-26, S 7.2.6, L 4-7	Clarify more specifically where evaluation of the groundwater protection pathway will be evaluated for rads.			
22.	P 7-27, S 7.2.7, L 3-7	It could be argued that any type of statistical analysis (including 95UCL calculation for EPC) is inappropriate due to biased (nonrandom) sampling. Also, biased sampling may be conservative or nonconservative, because bias may lead to overestimating or underestimating EPC, respectively.			
23.	P 7-27, S 7.2.7, L 13-14	Text states, "…maximum detected concentrations were selected as the EPCs for small sample size." However, OSWER 9285.6-10 (EPA, 2002) states, "It is important to note, however, that defaulting to the maximum observed concentration may not be protective when sample sizes are very small, because the observed maximum may be smaller than the population mean." Therefore, defaulting to max with small samples is allowed, only because UCL cannot be reliably calculated, not due to alleged conservatism.			
24.	P 7-27, S 7.2.7, L 27	"(Cook 2003)" is not listed in the references in Section 9.			
25.	P 7-33, S 7.5.2, L 1-2	Although Tier 1 SSLs for plants and soil invertebrates were not developed in CHPRC-00784, Tier 2 plant and soil invertebrate PRGs have been developed for nonrads for the Hanford Site (ECF-HANFORD-11-0158). These plant and soil invertebrate PRGs should also be used in this RFI (and BRA) for screening soil samples at WMA-C (in addition to wildlife PRGs).			
26.	P 7-33, S 7.5.2.1, L 15-16	In addition to ingestion of soil and ingestion of food, Figure 7-4 also appropriately identifies complete pathways for "uptake by plants/soil biota" from shallow soil and standing water, as well as "external radiation" from shallow soil for all receptors.			
27.	P 7-33, S 7.5.2.2, L	"WMP-20570" is not listed in the references in Section 9.			

	22				
28.	P 7-34, Figure 7-4	Cite CHPRC-00784, Rev 1 (Tier 1 soil PRGs) for this figure. Clarify why CHPRC-01311, Rev 2 (Tier 2 soil PRGs) is not cited and used in this RFI. Because Tier 2 values contain more Hanford site-specific information, Tier 2 values are arguably more relevant than Tier 1 values. Clarify that footnote "a" applies only to herbivores, insectivores, omnivores, and carnivores. That is, "dermal contact" is a complete and significant pathway for soil biota, invertebrates, and plants (as noted by the upper case "X").			
29.	P 7-37, S 7.5.2.3, L 23-25	"Beresford et al 2008" is not listed in the references in Section 9.			
30.	P 7-42, S 7.5.5, L 43-46	List chemicals with detection limit>SSL. These specific chemicals should be identified as an uncertainty. Preferably, detection limits<SSL should be employed for all chemicals.			
31.	P 7-43, S 7.5.5, L 9-10	MTCA defines the biologically active soil zone as 0-6 ft (not 6-15 ft), per WAC 173-340-7490 (4)(a).			
32.	p 7-43, S. 7.5.5, L 36-41	A 95UCL should preferably be calculated to represent EPC, independent of receptor type when local populations are considered. For example, a population of individuals of sessile biota (e.g., plants) or mobile biota (e.g., birds or mammals) may be distributed over a range of concentrations of a given soil COPC. As a representative measure of COPC soil concentration, EPC should attempt to capture variability in COPC concentration which is independent of receptor mobility/immobility. Therefore, a UCL95 (rather than max), which contains a measure of variability (standard deviation), is the best estimate of EPC for sessile biota (just as it is for mobile biota). In addition, use of max ignores most of the information in the data set.			
33.	P 7-45, S 7.7, L 43-46	If necessary, MCLs are adjusted to 1E-5 total site risk and HI=1 (WAC 173-340-720[7][b]). If there is no MCL, MTCA Method B groundwater cleanup standards are calculated at 1E-6 cancer risk and HQ=1 noncancer hazard (or HQ=0.1 to account for additive effects of noncarcinogens with a common target organ). In either case, MTCA total site limits are 1E-5 risk and HI=1.			
34.	P 7-46, S	Text refers to Section 7.3.2, but there is none. Clarify that the data set contained			

	7.7.2, L 36-38	25738 records and 300 analytes (before removal of excluded analytes and nondetects) for consistency with Figure 7-8.			
35.	P 7-49, S 7.7.3.2, L 37	"DOE/RL-96-61" is not listed in the references in Section 9.			
36.	P 7-49, S 7.7.4, L 44	Again, text refers to Section 7.3.2, but there is none.			
37.	P 7-50, S 7.7.4, L 1	Text refers to Section 7.3.3, but there is none.			
38.	P 7-50, S 7.7.4.1, L 27	Text describes one exclusion criteria as, "Analytes without known toxicity data information." This exclusion should be described as an uncertainty.			
39.	P 7-50, S 7.7.4.2, L 41-45	It should be explicitly stated that those 48 nondetects with [minimum MDL>comparison value] comprise an uncertainty in the groundwater risk analysis.			
40.	P 7-51, S 7.7.4.3, L 2-5	Text identifies 39 analytes with [max<comparison value], although text in RPP-RPT-58297 (p 5-2) identifies 31 analytes. Please reconcile.			
41.	P 7-51, S 7.7.4.4, L 12-15	Text identifies 14 analytes with [max>comparison value], although text in RPP-RPT-58297 (p 5-41) identifies 24 analytes. Please reconcile.			
42.	P 7-51, S 7.7.5, L 23-26	Briefly describe the analyte specific evaluation (e.g., consideration of background comparisons and spatial/temporal variations [RPP-RPT-58297]) that was performed to reduce the number of analytes to 7 groundwater analytes of interest (i.e., sulfate, V, Ni, nitrate, I-129, Tc-99, cyanide). Because a number of additional analytes in Table 5-4 in RPP-RPT-58297 (Sb, As, Co, Cu, CCl4) displayed FOD>1% and exceeded both comparison values (even if screened at HQ=1) and 90th percentile Hanford background levels, these analytes should also be retained.			
43.	P 7-52, S 7.8.1, L 11-13	Text states that rad risk for the industrial worker is no greater than 2E-4, but Table 7-2 shows rad risk of 6E-4.			
44.	P 7-52, S 7.8.1, L 22-24	Text states that rad risk for the adult resident ranged from 1E-3 to 7E-4, but Table 7-8 shows rad risk ranging from 2E-3 to 7E-6.			

45.	P 7-52, S 7.8.1, L 36-41	Text states, "For nonradiological COPCs, cancer risks and noncancer hazards indices fell below the acceptable risk value of 1 x 10-5 for multiple contaminants and multiple pathways (WAC 173-340-708[5])..." While true for the MTCA Method C industrial scenario (Table 7-3), this is not true for the MTCA Method B residential scenario (Table 7-9). ELCR≥1E-5 in several EAs for the resident (Table 7-9). However, with the exception of HI=2.4 in EA C, risks and HI≤background (Table 7-9).			
46.	P 7-53, S 7.8.3, L 30-33	Text states that 9524 records and 55 analytes in groundwater were carried forward (after data processing) for screening against human health comparison values. Data in Figure 7-8 slightly conflict with this.			
47.	P 7-53, S 7.8.3, L 35-38	There are likely more than 7 analytes of interest in groundwater (i.e., sulfate, V, Ni, nitrate, I-129, Tc-99, cyanide), considering FOD and exceedences of comparison and background values. At a minimum, additional analytes should include Sb, As, Co, Cu, and CCl4.			
48.	P 7-53, S 7.8.4, L 42-45	Fragmenting WMA C risk assessment analyses among different documents obstructs transparency (e.g., groundwater protection for nonrads in RPP-RPT-58329; groundwater protection for rads in WMA C Performance Assessment).			

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Document Number(s)/Title(s) RPP-RPT-58329, BRA WMA-C, Rev. 0	Program/Project/Building Number NWP - TSOC	Reviewer Damon	Organization/Group WA Dept of Ecology	Location/Phone Mike Barnes - Lead 372-7927

Comment Submittal Approval: Agreement with indicated comment disposition(s) Status:

Organization Manager (Optional) _____ Date

Reviewer/Point of Contact _____ Date

Author/Originator

Reviewer/Point of Contact

Author/Originator

Item	Page (P), Section (S), Line (L)	Comment (s) (Provide technical justification for the comment and detailed recommendation of the action required to correct/resolve the discrepancy/ problem indicated.)	Hold Point	Disposition (Provide justification if NOT accepted.)	Status
1.	P 1-1, S 1.1, L 27-33	Text states the following: "No groundwater evaluation was performed for the WMA C as it is currently being evaluated as a part of the 200-BP-5 groundwater remedial investigation report. In addition, a screening evaluation of groundwater conditions under WMA C is provided in a separate report. However, potential threats to groundwater are evaluated as part of the WMA C BRA. This portion of the assessment is referred to as the 'protection of groundwater pathway' and is used to understand potential impacts to groundwater from migration of nonrad contaminants in contaminated soil through the vadose zone to the aquifer." This administrative fragmentation of groundwater evaluation makes it difficult to assess risk from all pathways. Risk should include all exposure pathways and correspond to a relevant scenario for human receptors (e.g. residential property over 30 yrs) or presumed exposure setting for eco receptors (e.g., home range			

		over lifespan), rather than to an administratively fragmented set of exposure pathways (i.e., information dispersed in multiple reports).			
2.	P 1-1, S 1.1, L 30-31	The "protection of groundwater pathway" evaluation should cite Section 3.5.11 and should note that only nonrads are evaluated in this BRA (another example of fragmentation).			
3.	P 2-5, S 2.5, L 1-8	Note that the MTCA point of compliance (POC) for groundwater protection is throughout the vadose zone (ground surface to groundwater) (WAC 173-340-740[6][b]).			
4.	P 3-2, S 3.0, L 5	Add WAC 173-340-720 (groundwater cleanup standards).			
5.	P 3-3, S 3.1.1, L 37-42	Text describes one COPC exclusion criteria as, "Analytes without Known Toxicity Information." This exclusion should be described as an uncertainty. A recent editorial in Toxicol Sci notes, "Surprisingly, the current model deems that if we have no reliable toxicity data for a given chemical then it must be assumed to be safe. Although we may be blissfully ignorant of the toxicity this could indeed be very dangerous for the health of the human race and for the planet" (Miller, 2015) (http://toxsci.oxfordjournals.org/content/early/2015/02/25/toxsci.kfu310.full.pdf).			
6.	P 3-4, S 3.1.2, L 3-5	Eliminating nondetects is appropriate only if detection limits are sufficiently low (e.g., at established PQLs).			
7.	P 3-6, Table 3-1	Aroclors 1254 and 1260 are listed as COPCs in Table 3-1. A more informative, accurate, and sensitive measure of PCBs is quantitation of individual congeners, since commercial Aroclor mixtures are weathered (transformed) in the environment. In addition to summing congeners to evaluate total PCBs, individual congener analysis also allows evaluation of dioxin-like PCB congeners.			
8.	P 3-7, S 3.2.1, L 13	Text lists, "an environmental transport medium," as required for a complete exposure pathway. Note that this component is not needed for external radiation.			
9.	P 3-7, S 3.2.2.1, L 31-33	Text notes that only contaminants in the vadose zone (UPRs or planned releases) and surface soils (past operations) are addressed in this BRA. However, Figure 3-1 also includes "potential retrieval leaks." Please reconcile. Clarify why contaminants in residual waste in tanks and ancillary equipment are excluded in the BRA.			

10.	P 3-7, S 3.2.1.2, L 39-40	Text lists migration of contaminants via infiltration, percolation, or leaching, but Figure 3-1 does not. Please reconcile.			
11.	P 3-8, S 3.2.1.2, L 1-7	Text lists emission of dusts and vapors, generation of dusts, and volatilization of COPCs, but Figure 3-1 does not. Please reconcile.			
12.	P 3-9, Figure 3-1	For transparency, Figure 3-1 should be labeled as human health conceptual exposure model and should present all exposure pathways (even if all are not evaluated). Therefore, in addition to soil ingestion and soil inhalation, MTCA (WAC 173-340) includes soil dermal contact and soil contaminants leaching to groundwater with subsequent ingestion of groundwater by residential receptors. Also, CERCLA includes soil contaminants leaching to groundwater with subsequent ingestion of groundwater by residential and tribal receptors or other subsequent uses (e.g., showering, irrigation of crops). Contaminated groundwater may also impact fish in the Columbia River which may be consumed by residential or tribal receptors.			
13.	P 3-11, S 3.2.1.4, L 40-42	Re potential Columbia River impacts, text states, "The impacts of waste left within WMA C on these surface water bodies will be evaluated through the use of a regional fate and transport model." More detail is needed on this model, including where this information will be presented.			
14.	P 3-12, S 3.2.1.4, L 1-6	Text states, "Food chain pathways were evaluated for radiological COPCs. They were not evaluated for nonradiological COPCs as EPA does not provide intake equations or recommend performing food chain analyses for chemicals (EPA/540/1-89/002)." This is not true. EPA (RAGS) does recommend evaluating intake of chemicals in food (e.g., fish, produce, meat, dairy), and RAGS provides intake equations for chemicals in food. Therefore, both rads and nonrads should be evaluated in food chain pathways.			
15.	P 3-13, S 3.2.1.4.2, L 7-8	Dermal contact may also be evaluated for MTCA Method C industrial worker scenario (WAC 174-34-745[5][c][iii]).			
16.	P 3-15, 3.2.1.4.6, L 12-14	Exposure pathways for the CERCLA resident for food intake (produce, meat, milk) should include both rad and nonrad COPCs.			

17.	P 3-15, S 3.2.1.4.7, L 34-35	In addition to soil ingestion and soil inhalation, MTCA Method B unrestricted land use scenario includes soil dermal contact (WAC 173-340-740[3][c][iii]) and soil contaminants leaching to groundwater (WAC 173-340-747[4]) with subsequent ingestion of groundwater.			
18.	P 3-16, S 3.2.2, L 37	ProUCL 4.00.05 has been updated. Please use ProUCL 5.0 (Sept 2013) (http://www.epa.gov/OSP/hstl/tsc/software.htm#about).			
19.	P 3-17, S 3.2.2, L10-24; P 3-18, Figure 3-2	For EPC selection rationale, text refers to Figure 3-2. This figure recommends the max in cases where 95UCL is not calculated, 95UCL>max and Chebyshev UCL is not calculated, and Chebyshev UCL>max. However, ProUCL (version 5.0) states, "It is recommended not to use the maximum observed value to estimate the EPC term representing the average exposure contracted by an individual over an EA. For the sake of interested users, ProUCL displays a warning message when the recommended 95% UCL (e.g., Hall's bootstrap UCL) of the mean exceeds the observed maximum concentration. For such scenarios (when a 95% UCL does exceed the maximum observed value), an alternative 95% UCL computation method based upon Chebyshev inequality is recommended by the ProUCL software." Therefore, when possible, a 95UCL should be calculated to represent EPC. Only in cases where UCL cannot be not calculated (i.e., statistical analysis is not appropriate or not possible) should EPC defer to the observed max, noting the uncertainty in EPC. Exceptions where defaulting to max is allowed might include small sample sizes (e.g., n<5), low FOD (e.g., <20%), or focused sampling. Ecology has made this comment repeatedly.			
20.	P 3-18, S 3.2.3.1, L 19	Looks like AT should be in days (not hours).			
21.	P 3-43, S 3.2.3.1, L 17-23	Define AT (days).			
22.	P 3-44, S 3.2.3.2, L 14	CF is 1E-3 mg/µg.			
23.	P 3-45, S 3.3.1.1, L	Oral Absorption Factor (ABS) should be expressed as a fraction in these equations (not %).			

	20; P 3-46, S 3.3.1.2, L 15				
24.	P 3-46, S 3.3.1.3, L36-37	Text notes that the PPRTV database is not publicly available. This is not correct (http://hhpprtv.ornl.gov/index.html).			
25.	P 3-47, S 3.3.1.3, L 9-11	According to OSWER 9285.7-53, all sources for toxicity values that are not Tier 1 or Tier 2 fall into Tier 3 by definition. Therefore, NCEA/RAIS comprise Tier 3 toxicity values.			
26.	P 3-47, S 3.3.1.3, L 25-29	Clarify in text whether or not oral cancer risk will be assessed for Cr+6 with the NJDEP slope factor (0.5 [mg/kg-d]-1).			
27.	P 3-49, S 3.4.1.1, L 2-3	Total cancer risk for an EA is calculated by summing across carcinogenic chemicals and exposure routes.			
28.	P 3-49, S 3.4.1.2, L 43-44	As an initial screen, HQs for an EA are typically summed across chemicals and across exposure routes. If HI>1, chemicals are segregated by similar mode of action (chemical group), and corresponding HQs are summed within a chemical group and across exposure routes.			
29.	P 3-51, S 3.4.3, L 1	Note that 1E-4 is one case in ten thousand.			
30.	P 3-51, S 3.4.3, L 6-8 and 40-41	Note here (and other places in the text) that total ELCR limit for MTCA Method C is 1E-5.			
31.	P 3-52, S 3.5, L 16-17	Relegating Native American risk results to information purposes only may be perceived by Native Americans as essentially excluding these results.			
32.	P 3-53, Table 3-3	Add a footnote to this table (and similar tables), noting that bold font indicates ELCR or HI limit exceedences.			
33.	P 3-65, S 3.5.7, L 1-5	The first two sentences of this paragraph need clarification. The first sentence is nonsensical, and the second sentence does not identify an antecedent (i.e., higher risk than what?).			
34.	P 3-65, S 3.5.7.1, L 30	Please add Tc-99 (see EA P for rads in Table 3-9).			
35.	P 3-65, S	Re background noncancer hazard assessment, HQs should only be summed for			

	3.5.7.2, L 37-41	COPCs with similar effects. Therefore, it is not appropriate to sum HQs for As, B, Co, Fe, Li, and V to calculate HI=3 (Table 3-10). Separate background evaluations must be performed for each noncancer COPC (or COPC group), eliciting a similar effect. Resulting background HIs should then be compared with corresponding EA HIs to identify background effect.			
36.	P 3-67, S 3.5.8.2, L19-23	Re background noncancer hazard assessment, HQs should only be summed for COPCs with similar effects. Therefore, it is not appropriate to sum HQs for As, Co, Fe, and V to calculate HI=2.3 (Table 3-11). Separate background evaluations must be performed for each noncancer COPC (or similar COPC group), eliciting a similar effect. Resulting background HIs should then be compared with corresponding EA HIs to identify background effect.			
37.	P 3-70, S 3.5.11, L 16-21	Evaluating groundwater protection for nonrads and rads in separate reports fragments the evaluation, decreasing transparency.			
38.	P 3-70, S 3.5.11, L 35-45	This data evaluation should compare EPC with CUL (first bullet) or background concentration (second bullet). In the first bullet, text specifies "maximum detected concentration and EPC," while in the second bullet, text specifies "maximum detected concentration." EPC is the key metric which includes both max detect and 95UCL (Table 3-2).			
39.	P 3-72, S 3.5.11, L 1-29	Again, this data evaluation should compare EPC (max detect only in some cases) with CUL or background concentration.			
40.	P 3-72, S 3.5.11, L 32-37	The inference is that a "representative site-specific model" (presumably STOMP) will trump results of the MTCA three phase model in the case of CUL exceedences with the MTCA three phase model. Please clarify.			
41.	P 3-91, S 3.6.1, L33-34	Text states, "Current baseline conditions are represented by soil data collected from 13 biased sampling locations within WMA C." Text on p. 2-1 (Line 15) indicates 14 sampling locations. Please reconcile.			
42.	P 3-91, S 3.6.1, L37-38	Text states, "A total of 136 soil samples were collected at various depths (near surface [0 to 3 ft bgs], shallow surface [0 to 15 ft bgs] and deep [>15 ft bgs]) from 10 EAs within WMA C." However, Table N-1 (Appendix N) appears to show about 150 soil samples. Please clarify.			
43.	P 3-91, S	Text states, "Since, the RME receptors are exposed to contamination present in			

	3.6.1, L 41-44	the shallow surface soil, soil sampling results from the shallow surface zone (0 to 15 ft bgs) for each EA were then used to determine the source term during the risk assessment." This source term (shallow soils) does not capture a groundwater drinking scenario, where receptors ingest groundwater that has been contaminated by soil COPCs leaching to groundwater through the full depth of the vadose zone.			
44.	P 3-92, S 3.6.2, L35-38	Text states, "Therefore, maximum detected concentrations were selected as the EPCs for small sample size." However, OSWER 9285.6-10 (EPA, 2002) states, "It is important to note, however, that defaulting to the maximum observed concentration may not be protective when sample sizes are very small, because the observed maximum may be smaller than the population mean." Therefore, defaulting to max with small sample size (e.g., n<5) is allowed, only because UCL cannot be reliably calculated, not due to alleged conservatism.			
45.	P 3-95, S 3.6.3, L 13-15	Specify how many analytes (with no tox data) appear in Table 8-2 of RPP-RPT-57218 (since this document does not appear to be available on the web).			
46.	P 3-96, S 3.7, L 41-43	The cumulative risk threshold for MTCA Method C is 1E-5 (not 1E-6).			
47.	P 3-97, S 3.7, L 24-25	Add Tc-99 (EA P in Table 3-9) as a major contributor for the CERCLA residential receptor.			
48.	P 4-1, S 4.0, L 12-13, 37-39	Clarify why this document implements CHPRC-00784 (Tier 1 soil PRGs) but not CHPRC-01311 (Tier 2 soil PRGs) in the tiered assessment of the SLERA. Because Tier 2 values contain more Hanford site-specific information, Tier 2 values are arguably more relevant than Tier 1 values.			
49.	P 4-6, Table 4-1	Am-241 is listed incorrectly under nonrads.			
50.	P 4-8, S 4.3, L 40	Text refers to "Appendix D, Attachment D-1." For this SLERA, text should refer to "Appendix E, Attachment E-1."			
51.	P 4-9, S 4.3, L 10	Text refers to "Appendix D, Attachment D-2." For this SLERA, text should refer to "Appendix E, Attachment E-2."			
52.	P 4-11, S 4.4.1, L 16	Although Tier 1 SSLs for plants and soil invertebrates were not developed in CHPRC-00784, Tier 2 plant and soil invertebrate PRGs have been developed for nonrads for the Hanford Site (ECF-HANFORD-11-0158), and these should be			

		used in this BRA (and RFI) for additional screening of soil samples at WMA-C.			
53.	P 4-11, S 4.4.1.1, L 38-42	Text states, "Therefore, both dermal and inhalation exposure were assumed to be negligible." Re inhalation, this may not be true in burrowing animals for inhalation of VOCs (e.g.,; Gallegos et al, 2007 [ETC 26:1299-1303]; Carlsen, 1996 [Risk Anal 16:211-219]) and inhalation of metals (e.g., Bench et al, 2001 [ES&T 35:270-277]).			
54.	P 4-17, S 4.4.2, L 6	Text refers to "Appendix D, Attachment D-1." For this SLERA, text should refer to "Appendix E, Attachment E-1."			
55.	P 4-18, S 4.4.2, L 28	Text refers to "Appendix D, Attachment D-2." For this SLERA, text should refer to "Appendix E, Attachment E-2."			
56.	P 4-21, S 4.5, L 1-5	Although WMA-C area may comprise <1% of the killdeer home range, other nearby foraging areas at Hanford for the killdeer may be contaminated, as well.			
57.	P 4-21, S 4.5, L 13-20	Although EA P contamination will be remediated as a result of unacceptable human rad risk, Table 4-5 identifies H-3 and Sr-90 at EA P as eco rad COPECs to be retained in this SLERA. Remedial actions are a downstream risk management issue.			
58.	P 4-21, S 4.6, L 44-46	Text states, "A review was performed to compare the result of the minimum detection limit for each analyte with respect to its corresponding NOAEL- and LOAEL-based SSL. For most of the analytes, no SSL was developed due to unavailability of TRVs. The minimum detection limits for the rest of the non-detected analytes are less than their corresponding SSLs based on NOAEL and LOAEL." In order to provide more specific information on uncertainty regarding nondetects, please indicate the fraction of nondetects with detection limit above their TRV, as well as the fraction of nondetects with no TRV.			
59.	P 4-23, S 4.6, L 6	MTCA defines the biologically active soil zone as 0-6 ft (not 6-15 ft), per WAC 173-340-7490 (4)(a).			
60.	P 4-23, S 4.6, L 43-46; P 4-24, L 1-2	A 95UCL should preferably be calculated to represent EPC, independent of receptor type when local populations are considered. For example, a population of individuals of sessile biota (e.g., plants) or mobile biota (e.g., birds or mammals) may be distributed over a range of concentrations of a given soil COPC. As a representative measure of COPC soil concentration, EPC should capture variability in COPC concentration which is independent of receptor			

		mobility/immobility. Therefore, a UCL95 (rather than max), which contains a measure of variability (standard deviation), is the best estimate of EPC for sessile biota (just as it is for mobile biota). In addition, use of max ignores most of the information in the data set.			
61.	P 4-25, S 4.7, L 29-30	Although WMA-C area may comprise <1% of the killdeer home range, other nearby foraging areas at Hanford may be contaminated, as well.			
62.	P 4-25, S 4.7, L 37-45	Although EA P contamination will be remediated as a result of unacceptable human rad risk, Table 4-5 identifies H-3 and Sr-90 at EA P as eco rad COPECs to be retained.			